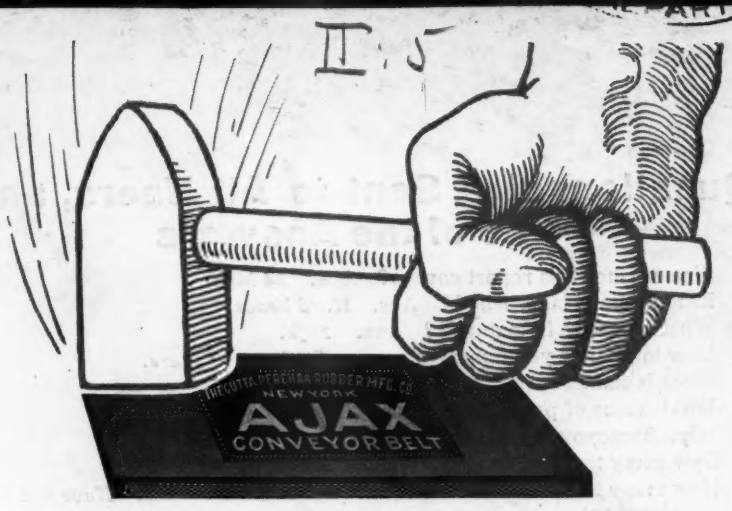
Pit and Quarry

SAND • GRAVEL • STONE

HANDLING • CRUSHING • SCREENING • WASHING



It Stands the Crushing Blows of Severe Service

Instead of being pounded to pieces by the constantly recurring blows of the hard material it conveys, AJAX CONVEYOR BELTING yields under those blows, sufficiently to absorb the shock. **That's why it lasts!**

The vitality of the belt is due to the proper combining of rubber and high grade duck. It is the result of 50 years of experience in the manufacture of practical belts, from the smallest to the largest.

For pit and quarry conveyor service, AJAX BELTING, will prove an all 'round, durable conveyor belt at a moderate price.

Write for prices.

The Gutta Percha & Rubber Mfg. Co.

NEW YORK, 124-128 Duane St. **BOSTON** **CHICAGO**, 303 W. Randolph St.
SAN FRANCISCO **PHILADELPHIA**

APRIL, 1918

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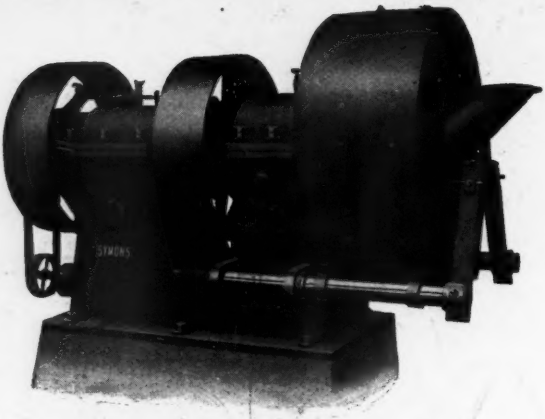
SYMONS DISC CRUSHER



Questionnaire Sent to All Users, and One of the Answers

Q. Size crusher this report covers? Ans. *24 inch.*
Q. Kind of material crushed? Ans. *Hard heads.*
Q. What moisture in material? Ans. *10%.*
Q. How long have you operated crusher? Ans. *2 years.*
Q. What is size of feed? Ans. *2 inches.*
Q. What is size of product? Ans. *½ inch.*
Q. What horsepower does it require? Ans. *20.*
Q. How many tons per hour does it crush? Ans. *25.*
Q. How many tons do you crush per pair of discs? Ans. *Have not replaced yet.*
Q. What percentage of time have you lost on account of breakage? Ans. *None.*
Q. Give your opinion of this crusher as compared to rolls. Ans. *Would not use rolls.*
Q. Give your opinion of this crusher as compared to a jaw crusher. Ans. *Jaw crusher makes too many spalls.*
Q. Give your opinion of this crusher as compared to a Gyratory crusher. Ans. *Has much greater capacity.*

Signed *Name on Request.*

Many more like this, also reports of the success of the crusher on different kinds of material.

Also built in sizes 18 in., 36 in. and 48 in. Immediate delivery.

Manufactured and Sold Only by

Chalmers & Williams

CHICAGO HEIGHTS, ILL.

Pit and Quarry

APR 8 - 1918
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Vol. 2 Chicago, Ill., April, 1918 No. 5

Quarry Men Advised of Future Outlook

THE DIRECTORS of the National Crushed Stone Association met at the Hotel Emerson in Baltimore, Md., February 26 and voted to incorporate in the state of Delaware. Much of the discussion pertained to the testing of materials, uniform cost accounting system, industrial insurance, labor matters, publicity and promotion work, by-products, freight rates and contractors relations, and on motion the president will appoint an executive committee from the board of directors which will also have supervision of the investigations of these matters. The committee will also elect a permanent secretary. Five memberships at $100 each were taken out in the Highway Industries Association.

On the following day the directors proceeded to Washington, D. C., where they had an appointment with Oscar A. Price, the personal secretary of Director General of Railroads McAdoo, at 10 A. M. February 27. Vice President John Rice was the spokesman for the quarrymen.

Mr. Price asserted his willingness to discuss the problems of the crushed stone industry and was informed that this is the critical season of the year for stone men, who must know now what to expect for summer work, whether or not cars will be furnished to move, whether or not railroad ballast work is to proceed aggressively and whether or not the necessary coal will be delivered.

Railroad Beds Will be Improved

The quarrymen were informed that every railroad bed will be put in excellent condition, that under government control all freight cars look alike and no matter to what road or system cars belong to they will be used on any system. Mr. Price further stated that "Two weeks ago we had a congestion of 187,000 loaded freight cars in this country. Under our new system this congestion in two weeks was reduced to 82,000 and that in two weeks more there would be no congestion. Eight heavy war freight trains are now running every 24 hours from Chicago to New York and ships at all coast points are being rapidly filled." He thought that under the new system all freight of the country could be handled, as Mr. McAdoo was determined to keep every car moving and every wheel turning.

Visit Public Roads Office

From Mr. Price's office the delegation went to the office of Hon. Logan Waller Page, Director U. S. Office of Public Roads. Mr. Page remarked that the amount of short haul freight over public roads was increasing at an amazing rate and expressed the belief that, while some obstacles now

appeared, there would be more money spent for road building in 1918 than usual. This was good news, and of particular significance by reason of the fact that Mr. Page's department determines the necessity of proposed roads which come for financial aid to the Federal Reserve Board. A committee of this board, guided by the advice of the Office of Public Roads, can hold up any bond issue amounting to more than $100,000, since it controls the funds in the Federal Reserve Bank.

After leaving Mr. Page's office, S. M. Williams, president of the Highway Industries Association, was visited in his office in the Colorado building. The next meeting of the directors or the Executive committee is subject to the call of President A. J. Blair, Milwaukee, Wis.

Cost Keeping for Quarries

Outlining the General System of Keeping Daily Operating Costs with Special Emphasis and Warning Against Average Costs.

In former articles the general outline for a cost keeping system was given, as well as how the cost of developing quarries should be handled. In this series of articles the elements of cost keeping and their need is placed before the reader in a simple, yet effective, manner. The fourth article will appear in an early issue.

OPERATING EXPENSES should be kept daily and in such a manner as to show the cost of each operation. Average costs are better than no costs, but little can be told from averages when more than one operation is being carried on in one quarry. One might just as well combine the costs of two different quarries, one operated by a competent man and the other by an incompetent. The former would have to pay for the inefficiency and ignorance of the latter.

By Daniel J. Hauer

IN SOME of the larger quarries many different breasts or faces of the ledge are worked so that some operations are extensive enough to be considered a series of quarries. If daily aggregate costs only are kept, the analyzed unit costs obtained are average ones only. Some quarrymen contend that this is what they desire, an average cost that tells daily if they are making a profit. This statement can be disputed, for it is evident that if a ledge is being worked at three different faces, each being known as a different quarry or as Nos. 1, 2 and 3, and the average costs show that a profit of 16 per cent, say, is being made in the entire output, this is not sufficient.

The case of such a quarry, each face being well developed, can be cited. The daily expenses in No. 1 is $100, while the receipts show $130. For No. 2 the cost is $80, while the stone sold for $100. In No. 3 the cost is $70, while

the receipts are only $59.50. Thus for the entire operation a cost of $250 is figured while receipts total $289.50, or an average profit of $39.50, or almost 16 per cent. Quarry No. 3 is being operated at a loss. Cut this out and No. 1 shows a profit of $30, or 30 per cent, No. 2 a profit of $20, or 25 per cent—a combined daily profit of $50, or an average of 27½ per cent. This percentage tells little, but the $50 speaks for itself.

If costs are kept in this manner, it is evident that No. 3 would be abandoned until prices became better, and more production secured from the other two faces of the ledge. This very thing is happening in too many quarries today. Don't confuse the development of a ledge, for new faces must be opened up at a loss, in most cases; reference is being made only to actual operations. The same thing is applicable to quarries being worked in two or more lifts.

The operating expenses should be kept daily and in such a manner as to show the cost of each operation. Average costs are better than no costs, but little can be told from averages when more than one operation is being carried on in one quarry. As well combine the costs of two different quarries, one operated by a competent man and the other by an incompetent. The former would have to pay for the inefficiency and ignorance of the latter. To keep costs separately may mean a little more work, but the labor so spent pays handsome dividends.

Loosening the Rock.

The general method of keeping daily costs to be outlined are applicable to averages or to each operation that may be carried on in one or more quarries. The first sub-heading to be considered is that of loosening the rock. This includes the drilling and blasting. It is not possible at this time to enter into a discussion of the many methods of drilling for blasting. This will be treated in other articles. It is the details of keeping the costs that will be considered, no matter what method of loosening is used.

The first cost to record is that of drilling. For this purpose the costs should be kept so as to reduce it to a cubic yard or ton basis, preferably the latter for crushed stone. Such a cost cannot be kept in the field except as an average cost, for the drilling may be done weeks and months in advance of the crushing of the stone. Of course, it is possible to obtain a general average cost of drilling by applying the daily cost of that work to the daily output. For instance, if the cost of drilling on Monday is $20 and the output was 300 tons of stone, then the average cost per ton for drilling may be 6⅔ cents. If however, drilling had been done on Sunday in order to have stone for Monday, and the expenses on Sunday had been $30, then this cost must be applied to the output on Monday, as crushed stone was not produced on Sunday. Thus the cost recorded on Monday would have to be 16⅔ cents per ton, which is clearly an erroneous cost.

The proper method is to keep the cost of drilling deep holes for an entire blast and after the blast is made to divide this cost by the number of tons loosened. Thus, if 5,000 tons are loosened in a blast and the cost of drilling was $250, the cost per ton is only five cents. The cost of drilling toe holes, block holes, etc., should be kept with the other daily expenses, for this work goes with the daily output, except in a few rare cases. The record should be so kept as to allow of daily comparisons. It is not enough to know some weeks or months after holes are drilled and a blast made that the cost of drilling has been 8 cents per ton instead of 4; this extra cost,

if it is to be prevented, must be discovered at the time of drilling the holes. Accordingly the costs should be kept on a lineal foot basis, and the approximate quantity to be loosened by a blast should be known so as to reduce these costs to a ton basis and allow of comparison, both as to the speed and cost of drilling. If a drill is cutting holes for 10 cents per lineal foot and this cost on one day jumps to 20 cents, an investigation should be made at once. Therefore, cost keeping forms should be so devised as to record the number of holes drilled by each machine each day, the depth of each hole, and a record should be kept of the location of the holes for each blast. This calls attention to the need of planning large blasts ahead in the office and field together, so that the most economical arrangeuent of holes is obtained and the blasting is thus made efficient.

In addition to the field forms there should be an office form for analyzing the field records and converting them to costs that can be applied to the quarry output when the product is made ready for sale. This again shows the need of carrying on all quarry work from an established base line with cross sections of the quarry run from this line. In this connection the reader is referred to page 63 of the January, 1918, issue of PIT AND QUARRY.

When blasting is done by the gopher method or small tunnels, the same thing is applicable to the costs, and they should be kept in a manner similar to that outlined for drilling. Much money has been wasted in some quarries using the gopher methods due to the fact that costs have not been so kept.

POWDER WASTED IN BLASTING

In recording the actual cost of blasting the same principle applies. Here we have two distinct items of cost. One of labor and the other of explosives and supplies. The record should be kept to show the cost of each item, otherwise too much explosives may be used, as is frequently the case. Naturally, it is better to use too much than too little, but it is surprising to note the excessive use of blasting powder in printed records of large blasts. If the proper records are kept of loosening rock they can be applied

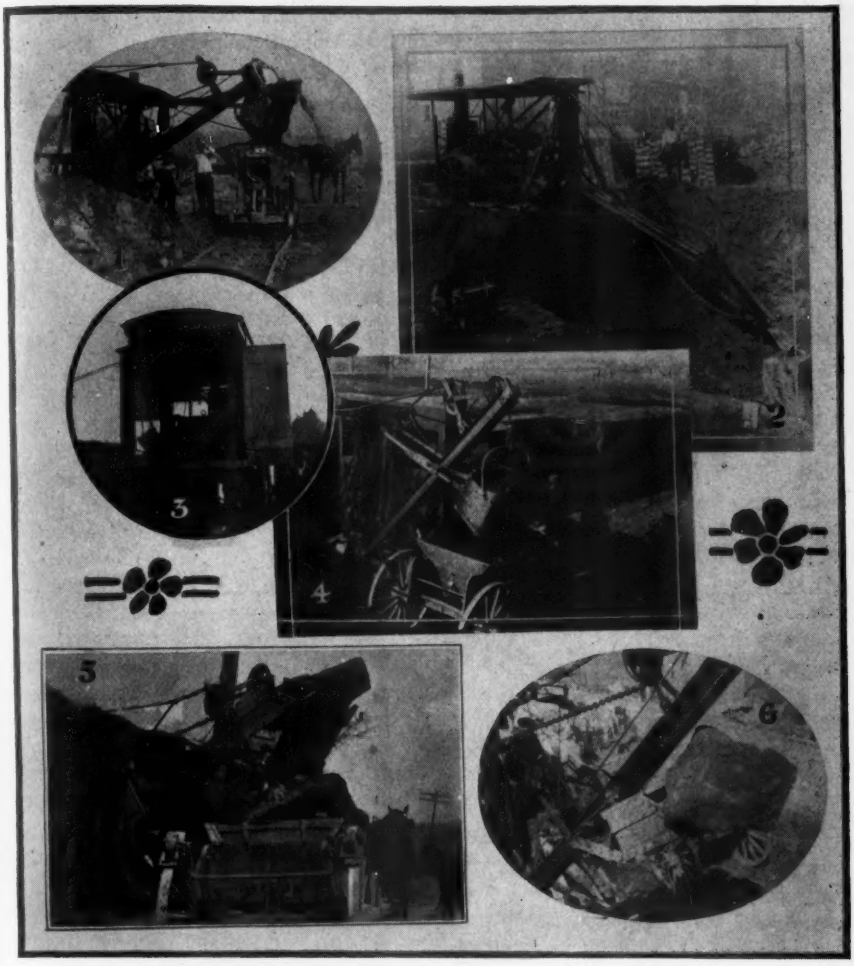
(Continued on Page 164)

Versatile!

THE 10-TON traction excavator shown above is all of that, and then some. The variety of pictures is explained by the fact that the machine has to date been used most largely for road grading and ditching work, although for the past two years it has been rapidly entering the sand and gravel and crushed stone industries because it possesses peculiar advantages for these operations. It uses two scoops — the flat-bottomed skimmer for shallow surface cutting and the draw scoop ditcher on sewer and trench excavating. It is the latter type that producers of material are making the most use of.

The machine is unusually portable. One Indiana sand concern who just purchased one expects to use it for excavating sand in an immense pit. Both the skimmer scoop and the ditcher scoop will be employed. In some cases the machine will be stationed on the rim of the pit and take out the material from below grade. Later it will be moved down to the tipple for loading material from storage piles into industrial and railroad cars. It can be moved about over comparatively long distances with ease.

The manufacturers, the Keystone Driller Company, Beaver Falls, Pa., also make a larger size, Model 6, which weighs 15 tons, built entirely of steel and actuated by a two-cylinder steam engine which develops 25 h. p. The larger machine has an 18-foot boom, and the horizontal crowding movement of the three-fourths-yard skimmer bucket is 14 feet. It will also handle the three-



In the pictures above No. 1 is a view of a Model 3 shovel with a half-yard dipper in the pit of the Bessemer Loam Sand Co., New Castle, Pa.; No. 2 shows the machine equipped with the ditching scoop being used for digging cellars, excavating below grade and loading into dump wagons. The scoop has a reach of 24 feet with the ditching attachment, and can be used for excavating to a depth of 18 feet. In Nos. 3 and 4 the machine is equipped with an electric motor, especially constructed with enclosed cab, taking out clay at a brick plant; No. 5, a half-yard skimmer scoop is attached for road grading. This illustrates the fact that it can be used to handle rocks of considerable size, and the machine can also be used for excavating fairly hard material like old macadam, shale or soapstone without previous blasting. Note that the half-yard skimmer is required for handling such material. No. 6 shows a large boulder poised on the teeth of the skimmer scoop.

fourths-yard dipper type scoop. The tread wheels and steering wheels are larger and have wider tires. The bigger machine is recommended for concerns wishing an extremely portable machine in combination with greater capacity than is possible with the smaller model.

Cost Keeping for Quarries.

(Continued from Page 162)

to the particular output of a quarry giving true costs that mean something instead of average costs that only show if a profit is made over a long term of time or a season.

Breaking and Loading

There are a number of methods of breaking boulders and these have been described in another article. Boulder breaking is done, as a rule, as the rock is to be loaded, and only in rare cases is the rock being broken one day and loaded upon another. There can be a daily record applying against the same day's output. The two items that apply against this cost are labor and explosives. The cost of all blasting for breaking boulders or shooting shallow toe holes should be kept separate from other blasting costs, as those of deep holes and tunnel blasting. The drilling cost for boulder breaking should be kept for the lineal foot and then converted to the ton basis in the office. Thus, there is always a check on the runner of feet drilled by each runner.

If the labor of breaking is done in connection with other work it is not necessary to try to keep it separate from such other costs, except to judge the results of various methods of spacing drill holes and blasting. If special men are detailed to operate drills for breaking, or a derrick, or even for sledging, the breaking cost can be kept separate from that of loading and a wonderful check can be obtained on this part of the quarry operation; but most sledging, in a large number of quarries, is done by the loaders, and it would be too expensive to try to keep a separate record. This is especially true of loading by hand, but if steam shovels are used or other mechanical means taken, then the breaking and loading become two separate operations.

Paying by Loaded Car System too Costly

The cost of loading will vary as to the method used and also the manner of paying for it. If machines are used to load cars, then to arrive at the cost the output must be divided into the total expense of the day, thus getting a unit cost. If hand loading is done and the men paid day's wages, the same method is followed and a form must be devised for this; but if men are paid a piece rate by the car or by the ton, then a different form must be used. This piece rate system is the best except in a few cases. The ton basis is the fairest, for to pay by the car may mean a disadvantage to the operator and, in some cases, to the workman. On the car basis, men never load any more than will pass as a car full, and some workmen, especially foreigners, become very expert in filling stone so as to make a large per cent of voids, thus reducing the output of the quarry and adding to all the costs. Cars only partly loaded cannot be run to the crusher in emergencies.

If the ton basis is used, the cars are loaded to their capacity, the output of the quarry is kept up, partly loaded cars can be used and a fair basis is established for both the operator and the workman. This means that scales must be installed somewhere between the quarry face and the crusher and all cars weighed.

Using a ton as the basis, the writer favors the ton rate, with a bonus for extra tonnage over a given number for a day's work. This means to obtain a maximum output and to reduce all the costs in the quarry. This method calls for a different cost form than when a straight piece rate is paid.

Culling

In many quarries the cost of culling is nil, while in others it is small or is done in connection in the sledging or loading, so that it cannot be separated. Under such circumstances a record of this cost is not necessary; but in some quarries, as for feldspar, flint, etc., culling is a considerable item and is done by men experienced in this work. Here a cost record is essential, for the grading of the product depends upon the culling, and this cost may be so great as to make the entire project inprofitable. The cost record should not only show the daily cost, but also the amount of reclaimed product and the amount of culled stone, for all the unit costs of quarrying must depend upon these two quantities. A form must be devised to cover these features and allow of easy analyzation.

Transporting to Plant

Transporting to the plant is an easy item to handle, as it consists of labor, horses, engines, materials or supplies and the plant charges pertaining to this part of the operation. If weighing is done it will also include this item. A simple form will allow these things to be listed and segregated. Not only will these costs vary according to the efficiency of handling the transportation problem, but also with the efficiency of the breaking and loading. If the loading end falls down and that cost goes up, the costs of transporting will increase. The two operations go hand in hand and the loading must be pushed and looked after closely if the cost of transporting is to be kept low.

Cost of Plant Production

In plant production is included all the costs of producing the product at the plant, except that of power, which may be distributed over a number of the eight operations of a quarry. The kind of a form for the cost of producing must vary with the kind of plant and the products of the quarry. This is easily recognized when one considers the difference between a crushed stone operation and the producing of marble for interiors of buildings.

Not only is it essential to keep the costs, but they must be kept in such detail as to make comparisons of the various parts of the operations and also daily comparisons so as to find out where money is being wasted. This does not mean a complicated form, but it does mean the listing of all details in such a way as to know the cost of each operation. Included with the labor cost should be that of supplies and also the plant charge. This last item is generally large and can readily equal the other costs of production. If the proper records are kept, the work of producing with the plant can be so systematized as to save many dollars in a year.

Handling and Storing

The cost of handling and storing varies in most quarries. In some it means nothing extra, while in others it may amount to many thousand dollars in a year. In the first named a record of such a cost is only a waste of time, but when this item of expense is incurred then a careful and exact record should be kept, for it quickly eats into the profits of a quarry. Ignoring this cost has too frequently brought operators to grief. Much depends upon the layout of a quarry plant and its system of conveying the product, in setting the cost of handling and storing as well as that of loading the product.

Loading the Product

In many cases these two costs can be grouped together. If the plant is well planned the cost of loading should be small, unless it is not possible to

(Continued on Page 177)

TABLE SHOWING THE NUMBER OF CUBIC YARDS OF ROCK DISPLACED PER FOOT OF BORE HOLE AT DIFFERENT SPACINGS

DISTANCE OF BORE HOLES BACK FROM FACE	DISTANCE BETWEEN BORE HOLES															
	5 Ft.	6 Ft.	7 Ft.	8 Ft.	9 Ft.	10 Ft.	11 Ft.	12 Ft.	13 Ft.	14 Ft.	15 Ft.	16 Ft.	17 Ft.	18 Ft.	19 Ft.	20 Ft.
5	.92	1.11	1.3	1.49	1.66	1.85	2.04	2.22	.....	.....	.....	.....	.....	.....	.....	.....
6	1.11	1.33	1.55	1.77	2.0	2.22	2.44	2.65	.....	.....	.....	.....	.....	.....	.....	.....
7	1.3	1.55	1.81	2.0	2.33	2.7	2.85	3.11	.....	.....	.....	.....	.....	.....	.....	.....
8	1.49	1.77	2.0	2.37	2.65	2.96	3.26	3.55	.....	.....	.....	.....	.....	.....	.....	.....
9	1.66	2.0	2.33	2.65	3.0	3.33	3.66	4.0	.....	.....	.....	.....	.....	.....	.....	.....
10	1.85	2.22	2.7	2.96	3.33	3.7	4.1	4.44	4.81	5.18	5.55	5.92	.....	.....	.....	.....
11	....	.....	.....	3.26	3.66	4.1	4.48	4.88	5.3	5.7	6.11	6.52	.....	.....	.....	.....
12	....	.....	.....	.....	4.0	4.44	4.88	5.33	5.77	6.22	6.66	7.11	.....	.....	.....	.....
13	....	.....	.....	.....	.....	4.81	5.3	5.77	6.26	6.74	7.22	7.70	.....	.....	.....	.....
14	....	.....	.....	.....	.....	5.18	5.7	6.22	6.74	7.26	7.77	8.30	.....	.....	.....	.....
15	....	.....	.....	.....	.....	5.55	6.11	6.66	7.22	7.77	8.33	8.88	9.44	10.0	10.55	11.11
16	....	.....	.....	.....	.....	.....	.....	7.11	7.70	8.30	8.88	9.48	10.07	10.66	11.3	11.85
17	....	.....	.....	.....	.....	.....	.....	7.55	8.18	8.81	9.44	10.07	10.70	11.33	11.96	12.59
18	....	.....	.....	.....	.....	.....	.....	8.0	8.66	9.33	10.0	10.66	11.33	12.0	12.66	13.33
19	....	.....	.....	.....	.....	.....	.....	.....	9.15	9.85	10.55	11.3	11.96	12.66	13.37	14.07
20	....	.....	.....	.....	.....	.....	.....	.....	9.63	10.37	11.11	11.85	12.59	13.33	14.07	14.81
21	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11.66	12.44	13.22	14.37	14.77	15.55
22	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.22	13.03	13.85	14.66	15.48	16.30
23	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.78	13.63	14.48	15.33	16.18	17.03
24	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.33	14.22	15.11	16.0	16.88	17.77
25	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13.88	14.81	15.74	16.66	17.60	18.51
26	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14.44	15.74	16.37	17.33	18.30	19.26
27	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15.0	16.15	17.0	18.0	19.0	20.0
28	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15.55	16.6	17.63	18.52	19.7	20.74
29	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16.1	17.18	18.26	19.33	20.4	21.48
30	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16.66	17.77	18.88	20.0	21.1	22.22

To reduce to tons:

For limestone multiply by 2.27
For traps, syenites multiply by 2.52
For granites multiply by 2.3
For shale multiply by 2.18
For glass, sand or gravel multiply by 1.55

Cost of Big-Hole Drilling

IT IS ONLY a few years since the advent of the well drill in quarry operations and its use has increased by leaps and bounds. It is best suited where the stratification of the rock permits and the height of the face is more than 25 feet. The cost of drilling a 5⅝-inch bore hole with a well drill may vary all the way from 20 cents to 60 cents per foot. In several operations the cost per foot is less than 30 cents. A good operator and helper in ordinary limestone, where strata are flat and other conditions favorable, can make from 20 to 60 feet per ten-hour day. In very hard rocks, such as traps, granites, etc., from 15 to 25 feet a day should be considered a fair day's work. It is fair to assume 25 feet per day and 30 cents per foot as an average cost for well drilling.

In the accompanying table are given the number of cubic yards or rock displaced per foot of bore hole at different spacings.

An average cost when three 60-foot well-drill holes are blasted is about as follows:

Drilling: 180 feet @ 30 cents = $54.00.

At 20x20 spacing=14.81 cubic yards per foot.

Three 60-foot holes=180 feet x 14.81 =2,665.8 cubic yards.

About 1,350 pounds of dynamite would be required.

1,350 pounds @ .125 cents per pound =$168.75.

Total cost: $168.75 plus $54.00 = $222.75.

Cost per yard: $222.75÷2,665.8 cubic yards=8.4 cents per cubic yard.

Labor Saving

The advantages of the well drill are numerous. By carrying the bore holes the full depth of the face the stone is loaded and treated on one working floor. It is unnecessary to employ a gang of men to bar down and clean off benches after the shot and to lift and lay tracks so frequently. A quarry where 15 men had been used for this purpose dispensed with them upon the adoption of the well drill. Loading operations are less frequent, thus lessening the danger. Stone can be shot down in greater volume and in better shape, making it economical to use a steam shovel. No bench cleaning to do makes it safer for the men.

Production Costs Dependent on Careful Selection of Explosives

Explosive cost is one of the big items in the production of stone and it is worth while to consult an experienced engineer or explosive manufacturer if your cost is too high or results unsatisfactory. During the last few years, low freezing straight, extra and gelatin dynamites have been introduced. These explosives do not differ in action from the high freezing ones and are just as efficient. Ordinary dynamite freezes at about 45° to 50° F. Thawing explosives in winter is expensive, dangerous and tedious.

Experienced Quarrymen Favor Large Bore Holes

It has been found by experience that it is just as cheap to drill a 5⅝-inch or 6-inch bore hole as one of smaller bore. The larger bore hole

QUANTITY OF EXPLOSIVES WHICH CAN BE LOADED PER FOOT IN BORE HOLES OF DIFFERENT DIAMETERS.—CARTRIDGES SLIT AND HOLES WELL TAMPED.

Diameter of Hole. INCHES.	Du Pont or Red Cross Gelatin. LBS.	Du Pont Straight. LBS.	Red Cross Straight or Du Pont Quarry. LBS.	Red Cross Extra. LBS.	Du Pont Extra. LBS.	Du Pont R. R. P. LBS.	Blasting Powder. LBS.
3	4.25	3.75	3.68	3.60	3.72	3.25	3.00
3½	5.68	5.10	5.0	4.89	5.07	4.42	4.08
4	7.55	6.60	6.53	6.33	6.62	5.72	5.28
4½	9.35	8.40	8.38	8.06	8.38	7.28	6.72
5	11.80	10.50	10.2	10.08	10.35	9.10	8.40
5⅝	14.94	13.2	12.8	12.53	13.0	11.3	10.44
6	17.0	15.0	14.7	14.4	14.9	13.0	12.0
6½	19.5	17.5	17.25	16.8	17.49	15.2	14.0
7	23.1	20.4	20.0	19.6	20.28	17.7	16.3
8	30.2	26.7	26.13	25.6	26.49	23.1	21.4

has the advantage of permitting a wider spacing and a better concentration of the explosives at the bottom, where it is usually most needed. It also requires the use of a heavier stem and drill bit, lending rigidity and steadiness to the machine and minimizing break-downs. Squibbing or springing well-drill bore holes is not recommended. It is a slow, tedious and expensive operation and is fraught with more or less danger. It is far better to reduce the spacing of bore-holes than to resort to springing. If the rock is very hard and the tow heavy or bottom hard to pull, oftentimes better results can be obtained by using an explosive of greater density, such as gelatin, in the bottom.

The smaller table, prepared by the Du Pont Company, gives the number of pounds of various explosives which can be loaded per foot in bore holes of different diameters, if the cartridges are slit and well tamped.

PROPER SPACING OF BORE HOLES

There is no hard-and-fast rule for the proper spacing of bore holes. All depends on the local conditions. With a 5⅝-inch bore hole, which is more commonly used, it is advisable at first not to exceed 20x20 feet in limestones. In harder rocks it is well to begin with closer spacing than this at first, say 15x15 feet. It is a good plan to begin low and work up. This is a subject requiring study by the quarryman to suit each local condition. As a general rule, the bore holes should never be drilled more than 20 feet apart.

Patent Holder Cannot Decide Resale Prices.

The Supreme court on March 4, in the case of the Boston store of Chicago against the American Graphophone and the Columbia Graphaphone companies, held that neither the patentee nor the wholesale dealer can fix the resale price. The decision of the court was handed down by Chief Justice White and Justice Brandeis. Chief justice said in effect that the price fixing system cannot be justified either under the general law or the patent law.

Drilling Down Costs

IN EVERY QUARRY there is room for one or more portable air compressor drilling outfits. In smaller quarries it does away with hand work and should be adopted. What is the use of having a large force of tired men about, when the same amount of work can be done with a few men and one machine. The outfits can be set in any position — the hose can be led anywhere.

The flexibility of the hose, by the way, adds much to the value of the machine. It can be coiled and gotten out of the way when blasting, and besides it actually prolongs the operating season.

Fuel costs half a cent a foot of drilled holes, and one man can drill as high as 200 feet of holes per day in ordinary rock. These holes are of the right diameter to take the stick of dynamite. This is as much as you could get done with four gangs of men with two men to the gang. It means a saving of seven men on such a job.

Many of the more profitable quarries use large well drills or very heavy steam drills for their deeper holes, and then they split up the boulders by the use of air compressor equipments. Other quarries use the latter entirely. Drilling up to six-foot holes with the No. 2 machine (the Schramm type is used for the illustrations), which weighs only 1,200 pounds. When deeper holes are needed, the No. 3 machine is used. This one weighs 2,200 pounds, and, with the rotating type of hammer drill, will drill holes up to 12 feet deep.

The No. 2 compressor is generally used with the Schramm Special rock drill, or drill of similar nature. The lower picture shows a quarry with some of the softest as well as some of the hardest sandstone, in which a No. 2 compressor is drilling with the special rock drill. These portable compressors can take care of any grade of stone from the hardest granite down to the softest shale.

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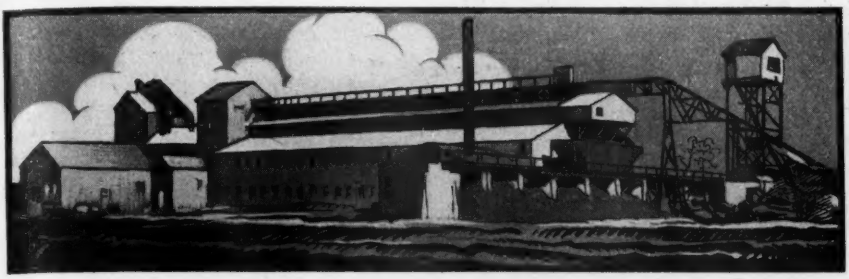


The Plant of the Ohio Hydrate & Supply Co., Woodville, Ohio, Is Nearly Automatic. At the Left Is North; Right, South. Small House on Tower at Right Is for Man Who Controls the Hoists

Ohio's New Lime Plant

Designed Throughout So as to Be Practically Automatic—High-Grade Material Produced at Comparatively Low Cost.

Explanation of Pictures on Opposite Page

Fig. 1—Pulverizers which receive the lime from the hydrator. Fig. 2—Battery of twelve double cylindrical and steel jacketed lime kilns. Fig. 3—Steel floor under the kilns onto which the lime falls. Fig. 4—Storage bins, and bagging machines under them. At left is the agricultural, and at right the hydrate equipment. Fig. 5—Grinder which receives the clinker from the pan conveyor under the steel floor shown in Fig. 3. Fig. 6—Continuous hydrator, which handles 14 tons an hour. The poidometer, which weighs the lime before hydration, is on top of hydrator. Fig. 7—Fans which blow pulverized lime to steel bunker.

SO PRECISE is the adjustment of one machine to another in the new plant of the Ohio Hydrate & Supply Co., Woodville, Ohio, that less than twenty men (not counting the quarry force) are required to produce 300 tons of high-quality hydrated lime daily from its twelve kilns and automatically controlled hydrator. Hand labor is reduced to the lowest possible degree — machinery works with almost human intelligence, and with far greater efficiency, regularity and dependability.

The plant ranks high among modern institutions whose cardinal principles are a superior product, maximum capacity and minimum operating cost. It is located about one mile south of Woodville, fifteen miles southeast of Toledo, and produces Ohio White Finish, trade-marked with the letters "O" and "H," the O circling the H.

Loading the Stone

As operations only began the latter part of last July, the quarry hole has not taken on such dimensions as to require ponderous equipment. There is not room on the quarry floor at present to operate a steam shovel, therefore the cars are loaded by hand. There are twelve Atlas steel, gable-bottomed cars, and although the company pays high wages it has been found that the low sides of the cars permit their being loaded, two men to a car, quite economically and at the same time the workmen are contented.

One Clipper drill makes 5⅝-inch

holes for blasting the rock down. The quarry face is 35 feet high, with no overburden. A Lidgerwood hoist draws the cars by cable up the 200-foot incline on a 30 per cent grade, after which the track becomes level and extends over the tops of the battery of kilns, as shown in the picture above. An ingenius tripping device enables the hoisting man to dump at any point desired. Contrary to precedent, the man controlling the hoist is not stationed directly above the kilns, but in a detached tower, as shown by the picture. He has a perfect view of the pit and plant and escapes the gases from the kilns. A second Lidgerwood hoist pulls the empty cars back to the quarry. The quarry at present is round in shape, but will be lengthened to further reduce the hauling cost, because it will require fewer tracks.

Coal arrives over an elevated track in hopper-bottom cars which dump onto storage piles below. The picture shows the location of the track. From the storage piles it is elevated to a Pittsburg grinder and again elevated to the stokers alongside the top of the kilns. All elevating and conveying machinery was furnished by the Webster Mfg. Co., Tiffin, Ohio. At present the kiln firemen obtain coal by pulling a lever which lets the coal into each kiln by gravity, but this method is to be changed so that the coal will be deposited into a 14-ton hopper at each kiln and fed to the fires by an automatic stoker furnished by the Ko-Shovel Stoking Machine, Chicago, Ill., operated by two Lincoln motors.

Twelve Double Kilns

There are twelve double kilns (Fig. 2), cylindrical and steel jacketed, 24 feet 6 inches from the arch to the top of the brick work, with a five-foot skirt. The shell is 12 feet 6 inches in diameter. The kilns are arranged in a single row and have chokes located in the upper part. Two holes in each kiln do away with the repairing of two walls. Heat is under perfect control and uniform burning assured by the interior construction. The kiln house is 170 feet long and 80 feet wide.

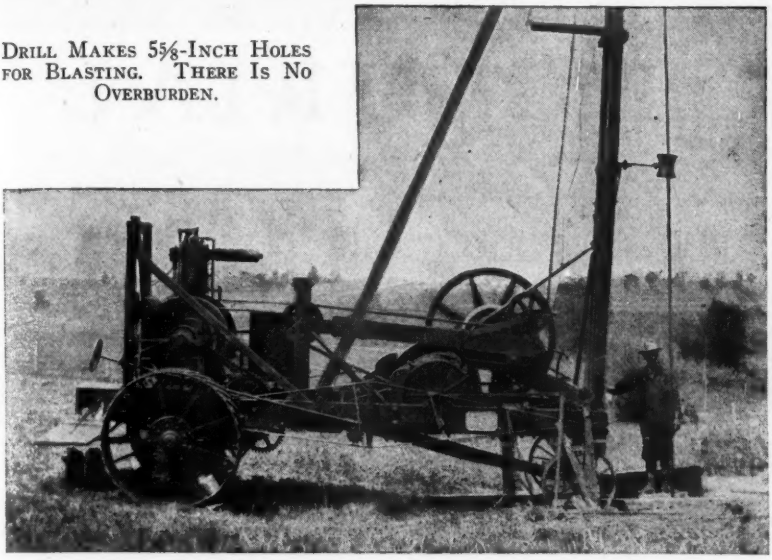
Calcined stone is drawn from the bottom of the kilns by Webster draw shears. It falls onto a steel floor (Fig. 3) under which is a pan conveyor extending the entire length of the building. A workman merely has to turn the wheel to obtain burned rock and is far enough away from the opening to escape the intense heat, but even this method is to be improved by the installation of an automatic air device that will reduce the number of men.

The Poidometer

A workman picks out the cores—always a very small number—and opens a sliding steel door that lets the lime into the pan conveyor in the floor. It is taken to a No. 4 Pennsylvania grinder at the north end of the building (Fig. 5) and then elevated to a steel bunker holding 300 tons. From here it is again elevated, to the Schaffer poidometer which automatically weighs the lime. Water is added, its flow regulated by an eccentric. Should the water stop, or the lime run too freely or stop altogether, the machine stops. There is a small hopper on the top of the poidometer, and when this hopper is filled the elevator supplying it stops; when the lime is fed out down to a certain level the elevator starts running again. The poidometer can be started or stopped by pushing a button.

Continuous Hydrator

Below the poidometer is the Schaffer continuous hydrator (Fig. 6), which handles about 14 tons an hour.



DRILL MAKES 5⅝-INCH HOLES FOR BLASTING. THERE IS NO OVERBURDEN.

Its mixing consists of a furrowing action working in conjunction with centrifugal force, always under control. From the hydrator the lime is taken by screw conveyor to two Raymond No. 2 pulverizers (Fig. 1) and a No. 11 spiral air separating system, all being direct connected, which blows the finely ground lime to two hydrate storage bins (Fig. 4, at right) holding 150 tons. The tailings go to another storage bin (Fig. 4, at left), which delivers to a two-tube bagging machine that puts it up for agricultural use.

LIME STORAGE

Under the hydrate bins are two four-tube Bates' valve bagging machines (Fig. 4). The bagging room forms a "T" with the kiln room and is 50 by 150 feet. Both the bags of hydrate and agricultural lime are stored in this room, and are loaded into railroad cars by men with trucks, 10 bags to a truck. The loading track extends along the north end of the plant. Every hour a man takes check weights from each tube to insure against a divergence in weights. President Price has evolved a system of blanks on which these weights are recorded and filed.

The lime produced has a quick initial set and a slow final set. It is a high-quality hydrate, and because of the efficient design of the plant the producing cost is extremely low when the character of the material is considered. W. H. Price is president of the company, and also general manager. The Schaffer Engineering & Equipment Company, Tiffin, Ohio, designed the plant, John C. Schaffer personally supervising the installation of the equipment.

I am surprised at the excellent start that you have made. Anyone who will notice that the statements made are from experts, people who have made the sand, gravel and crushed stone business a business, in other words, a success.—W. G. Heller, France Stone Co., Middle Point, Ohio.

EDITORIAL

Pit and Quarry
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The 1918 Market

MATERIAL PRODUCERS have been wondering since the first scarcity of railroad cars, introduction of priority orders and subsequent reports reflecting in variable degree on roadbuilding, just where they would "get off at" when the 1918 operating season came around. For a time conditions seemed to warrant gloomy forebodings. It appeared, despite the fact road building material men have millions of dollars invested in an industry of wholesome character and one indispensable to the needs of mankind, that markets would be taken away, operations throttled and huge losses sustained while at the same time many other activities ranging downward from luxuries to parasites would thrive and prosper.

It was a time for supreme optimism—possibly without available facts upon which to base its reasoning except an unshakable belief in the ultimate triumph of fairness and justice. To put out of commission the sand, gravel and crushed stone business would be neither fair nor just, and so the production of these materials will not be stifled by any condition—not even war. Since our war is a struggle for the supremacy of righteousness, it will be found (it is even now officially recognized) that these materials will fill a large measure of usefulness in attaining the victory that is sure to come.

That this view is correct, we feel, is justified by the gradually developing conviction of Official Washington that good highways and improved railroad beds are necessary to the successful conduct of the war, and these will require vast quantities of materials even if the program of the Government is only partially carried out. It is true that the demand for materials will be of a different character from that of previous years. There will not, for instance, be anything like the usual amount of residence, sewer and general construction work; but highways, ballast for railroads and materials for factory construction, in addition to all kinds of Government work, will consume such quantities as will keep plants in continuous operation, and it is up to producers to make their materials conform to these requirements.

Road Building Plans for 1918

THAT MORE than a quarter of a billion dollars—82 per cent more than in any previous year—will be spent for highway improvement in the United States during 1918, is the conclusion of the Goodrich touring bureau, an elaborate organization maintained by the Goodrich tire manufacturing company. The bureau has been making a detailed survey of the nation's road building plans, through inquiry of highway commissioners in the various states, and the results were made known a few days ago.

The exact total of proposed expenditures through federal, state and county channels is reported as $263,096,610. This exceeds the 1917 total by $118,797,750. Appropriations in the middle West and South are far greater than those in other regions, Texas leading the roster of states with a road budget of $25,000,000. Indiana and Illinois come next with approximately $17,000,000 apiece.

The amounts to be spent on road improvement this year, as compared with those of last year, are reported as follows:

States—	1917.	1918.
Alabama	$. 150,000	$2,500,000
Arizona	750,000	3,000,000
Arkansas	4,000,000	12,299,000
California	3,210,000	12,000,000
Colorado	3,100,000	3,635,000
Connecticut	2,500,000	2,500,000
Delaware	320,000	1,000,000
Florida	2,000,000	2,750,000
Georgia	3,500,000	4,300,000
Idaho	800,000	800,000

Cheer Up—The Doctor Is Coming

Illinois	5,500,000	17,000,000
Indiana	6,000,000	17,380,000
Iowa	15,140,000	15,500,000
Kansas	6,500,000	10,500,000
Kentucky	4,500,000	4,500,000
Louisiana	8,000,000	5,300,000
Maine	400,000	1,150,000
Maryland	2,250,000	2,700,000
Massachusetts	4,500,000	3,083,000
Michigan	1,500,000	2,300,000
Minnesota	3,884,925	7,700,000
Mississippi	1,500,000	3,500,000
Missouri	2,500,000	4,000,000
Montana	2,000,000	3,000,000
Nebraska	3,500,000	1,279,757
Nevada	300,000	560,000
New Hampshire	1,038,704	587,000
New Jersey	4,500,000	8,100,000
New Mexico	500,000	1,500,000
New York	7,000,000	10,000,000
North Carolina	1,750,000	2,500,000
North Dakota	1,000,000	3,500,000
Ohio	2,829,858	6,000,000
Oklahoma	3,500,000	6,400,000
Oregon	1,371,226	5,653,516
Pennsylvania	3,250,000	5,750,000
Rhode Island	481,724	669,000
South Carolina	1,173,000	1,498,000
South Dakota	350,000	1,500,000
Tennessee	2,000,000	3,000,000
Texas	5,000,000	25,000,000
Utah	943,129	1,131,754
Vermont	485,000	685,000
Virginia	2,332,577	2,115,000
Washington	3,500,000	8,408,250
West Virginia	8,000,000	14,000,000
Wisconsin	4,588,717	10,125,000
Wyoming	400,000	806,000
Totals	$144,298,360	$263,096,610

Renwick—Pioneer.

THE STORY of the business experience of Frank W. Renwick, president of the Chicago Gravel Company, Chicago, is equivalent to the history of the development of the sand and gravel industry. Mr. Renwick is a pioneer and a man whose perseverance and energy has had a great deal to do with the now general acknowledgment of the suitability and use of sand and gravel for concrete and road work.

Mr. Renwick is called an extreme optimist. Well, he's all of that; but his optimism has always made good. He refuses to bow down to disastrous reports affecting markets or railroad cars, or attacking the merits of sand and gravel as a material.

It was twenty-two years ago that he entered the sand and gravel business. Little was known about the material, especially in regard to screening, grading and washing, and certainly it was not recognized as suitable for concrete. In fact, little was known about concrete.

With two personal friends Mr. Renwick organized the Calumet Improvement Company for the purpose of promoting good roads. Lake county, Illinois, was just beginning its road work, and Mr. Renwick's partners believed that gravel macadam would be better than stone macadam. Mr. Renwick admits that it was then all "Greek" to him. There were two or three very small plants near Chicago producing torpedo, roofing and "ramming" gravel, the latter being under one inch, used for filling the spaces

F. W. RENWICK
President Chicago Gravel Co.,
Chicago, Ill.

between cedar blocks in paving work. All gravel over one inch was thrown away. Nobody knew what to do with it.

His partners found the gravel business no longer interesting, and he decided to go it alone. Later, because of transportation benefits, he consolidated with Rowell Brothers at Joliet and moved the plant to the Rowell pit, although the Calumet Improvement concern was still kept intact. The Hammond plant near Elgin was taken over a year or two later and Mr. Renwick purchased the Rowell interests and formed the Chicago Gravel Company. He installed the first crusher in the Chicago section, crushing the material dry.

The latter concern has operated from three to seven plants at one time. It is now working three, at Plainfield, Joliet and Spaulding Station, near Elgin, with an output which averaged 200 cars daily last summer. He has seen improvement in machinery from the "goat-and-wheelbarrow" and "coffeemill" period to the 214-ton shovel and No. 9 crusher which are now working at one of his pits. He installed the first steam shovel, a 45-tonner, ever used in a gravel pit. Cars (boxcars) were formerly loaded with wheelbarrows.

Mr. Renwick gave much of his time to the formation of the now sturdy National Association of Sand and Gravel Producers. He worked hard to bring about the first meeting, on December 15 and 16, 1912, was its president until January, 1917, when he was made treasurer. He feels that the honor should be shared by his co-workers and at the 1918 convention in Chicago withdrew from the race for presidency with Harry Donnelly, then president, stating that under Mr. Donnelly's administration the association had made such remarkable headway that Mr. Donnelly should be honored with a second term.

Cost Keeping for Quarries.

(Continued from Page 165)

ship promptly and it is deemed advisable to continue the production, when the cost of rehandling the product and ultimately loading it will be unusual. For some kinds of loading the cost is so small that it need not be considered, as when crushed stone is loaded from bins onto wagons and trucks, the drivers attending to the loading, so that this cost is included with the deliveries.

If there is a special cost for the loading, even if it is but one man, this cost should be kept separate so as to distinguish it from the other costs. The main thing is to know each item of cost whether large or small.

Power Costs

Power from a central or from one or more power plants must be used in a number of the operations, as pumping, drilling, transporting, producing, handling products and others. The costs should be kept to show the total daily cost of the power, and also to distribute it over all the items. With a number of different power units this is not very difficult, but if a central power plant furnished all power or to a greater part of the machinery or if electricity is used, and measured at one meter, then the power costs must be distributed by some arbitrary rule. If this cannot be done, the power cost can be treated as an overhead charge and recorded as such upon each day's operation. These overhead costs will be taken up in another article.

We thank you for the past issues of your interesting little paper and will appreciate receiving it regularly. Especially do we congratulate you upon the attention you have given to the office end of the business and sincerely hope that you will continue such a department and help every stone and gravel man to establish a good and reliable accounting and cost system in his business.—F. E. Bushey, G. M. Bushey & Son, Cavetown, Md.

Detached Screen at the Plant of the Standard Builders' Supply Co., Grand Rapids, Mich., Permits a Special Grade of Dry Material to Be Made

A Three-in-One Plant

Material Can Be Produced Dry, Washed or Crushed, Separately or in Combination, as Desired.

THE PLANT of the Standard Builders' Supply Company, Grand Rapids, Mich., is unique in its design, in that three kinds of material can be produced separately or in combination, according to market requirements. In Michigan certain quantities of material are produced dry for winter work, and provision has been made for this feature in the form of a screen detached from the regular washing and crushing plant. The plant was constructed early in 1916 and has a capacity of 600 yards per day. It is located one mile south of of Grand Rapids on the Pere Marquette railroad.

An Erie steam shovel excavates the material and places it in a hopper which straddles a 24-inch portable conveyor belt. It is transferred to another 24-inch conveyor belt on an incline leading to a 42-inch by 16-feet dry screen, which takes out dry material for winter work. This is done usually late in the fall; in the summer it is by-passed to the inclined belt conveyor leading to the washing plant. There is a shipping track on the side and bins under the dry screen just mentioned.

Leaving the dry screen, the material is chuted onto a 24-inch belt conveyor, just mentioned, which takes it to the top of the washing plant. This belt conveyor is on 210 feet centers. At the top of the incline the material passes through a 3 by 12-foot grizzly with 2½-inch openings, the rejects going to a No. 4 gyratory crusher and thence to a 18-inch belt conveyor back to the dry screen.

It is evident, therefore, that this system enables the plant to produce material dry, washed or crushed. The latter is known as "crushed stone," for which there is a local market.

The material that goes through the grizzly is passed through six 72-inch Gilbert screens, three in a row, and into two settling boxes, from where it goes into the bins. Six different sizes of material are produced as follows: Crushed stone, ¼ to 1 inch; also ¼ to 2 inches; crusher chips and dust; screened and washed gravel, ¼ to 1 inch; also ¼ to 2 inches; and torpedo sand. All stone above 2 inches in diameter is crushed and put into separate bins, graded to size; or it can be run over the screens in the main washing plant and mixed through with gravel. A loading track alongside the washing plant permits shipments in railroad cars.

Inasmuch as the plant is located on a concrete road, and the further fact that it is near the city, the motor truck trade is heavy. During 1917 the company operated seven trucks daily, in addition to the railroad cars it was able to obtain.

Besides the unusual design of the plant, the machinery has had practically no break-down troubles with consequent repair bills. The Erie steam shovel, for instance, has been in constant service, and although one dipper has worn out nothing has been spent on repairs. The screens and belt conveyors were furnished by the Stephens-Adamson Mfg. Co., Aurora, Ill.; the crusher is a No. 4 gyratory Austin, and the motors were supplied by the Allis-Chalmer's Mfg. Co. Electric power is used throughout.

The plant was designed by J. C. Buckbee, of Chicago, and erected under the supervision of N. H. Battjes, general manager.

Indiana Gravel Specifications.

SAND, gravel and stone are going to play an important part in Indiana's road program. Only a general idea of the specifications can be given at this time, because the new highway department has not fully determined upon the final draft. It is the present intention to make quite an exhaustive study of the road building materials of Indiana before final specifications are drawn. The new highway law provides for the co-operation of the state highway engineer and the state geologists at Purdue and Indiana Universities in examining and reporting upon the quality and availability of road building materials, and the testing laboratory at Purdue University is available to the highway department free of cost.

The following specifications on gravel was offered by State Highway Engineer Wm. E. Moore in his address at the third annual dinner of the Indiana Sand and Gravel Producers' Association.

> The gravel shall consist of clean, tough, durable stone of high resistance to abrasion, washed free from clay or coatings of any character. "Run-of-the-bank" gravel or gravel containing disintegrated or soft stone shall not be used. The gravel shall be uniformly graded from fine to coarse—not more than five per cent (5%) by weight shall pass a laboratory screen having circular openings one-quarter (¼) of an inch in diameter, and not less than thirty per cent (30%) or more than forty-five per cent (45%) shall pass a laboratory screen having circular openings of one (1) inch in diameter. One hundred per cent (100%) shall pass a screen having circular openings of two (2) inches in diameter.

Hydraulic Dredging

The hydraulic or suction dredge has been proven to be very economical in handling sand and gravel, not only dredging the material but delivering it to just the point desired as regards distance and height, all with one operation. The cost of a dredge, considering its capacity, is extremely low. In operation, the dredging pump creates a partrial vacuum in the suction pipe, sufficient to draw in the material and keep it moving through the discharge pipe line to distance desired, and at the same time elevates it to a reasonable height.

WHILE a centrifugal dredging pump is in itself quite simple, it has taken many years to perfect it into the present efficient machine. There is hardly a piece of machinery that has to withstand harder service, and it must be properly designed and built to stand the wear due to the material passing through.

Hundreds of these pumps, ranging in sizes from 6-inch to 20-inch are used in the Western rivers for dredging sand and gravel for building purposes and other uses. Here usually the sand lies loose and the suction force of the pump is sufficient to draw it into the suction pipe and obtain a satisfactory capacity without the aid of an agitator.

THE DREDGE for recovering sand and gravel is exceedingly simple, consisting principally of the dredging pump with its driving equipment mounted on a scow. The suction is a pipe of sufficient length to reach to the bottom, with a piece of flexible suction hose in the pipe to give the necessary flexibility so that the suction can be raised and handled as desired. The material is usually delivered into a flat deck scow with raised sides, so that the sand is retained and the water flows back into the river. Sometimes these dredge boats are self-propelling and provided with hoppers into which the material is pumped.

If, occasionally, the material should be found too hard packed, a few jets of water under pressure from a centrifugal pressure pump delivered at the suction intake will help in boiling up the sand so that the pump can draw it in to better advantage. For general dredging service where all classes of material will be handled, it is necessary, however, to use an agitator or cutter to cut and loosen the material, after which the pump will draw it in to the suction pipe.

Here the suction pipe is mounted within a structural steel ladder hinged to the dredge, of suitable length to dredge to the depth required, and of very heavy proportions to stand the strain due to dredging in hard material. The cutter is provided with a series of cutting blades and is mounted on a powerful shaft supported on the ladder and driven through gearing

from an independent engine. If properly constructed even shale rock can be dredged.

Usually two spuds are arranged in the stern of the dredge to act as anchors to hold the dredge in position. By means of swinging lines to either side of the dredge controlled by a hoisting engine, the dredge is swung from side to side on the spud as a pivot and thus the dredge can also be moved forward as the work progresses and the dredging operation be perfectly controlled.

Regulating the Material Handled

Naturally the dredge is the most efficient when handling the greatest amount of material with the least amount of water. By the use of the rotary cutter and by systematically swinging the dredge and moving forward on the spuds, the amount of material fed to the pump can be regulated so that the dredge is carrying the maximum percentage of material constantly.

The operator or lever man has before him a vacuum gauge showing the vacuum in the suction pipe and a pressure gauge showing the pressure in the discharge pipe; the reading of the vacuum gauge when handling material is greater than when pumping water only, and the operator shortly becomes proficient so as to keep the vacuum reading at the point which carries the greatest amount of material without choking the pipe. The pressure gauge reading will vary with the length of the discharge pipe used and with the elevation, but by its aid the operator is also able to tell when the dredging operation is perfectly normal.

The discharge pipe from the dredge is made up in pipe lengths joined together by flexible rubber sleeves and carried by pontoons to the shore. On the shore the pipe ends are telescoped together, giving a certain amount of flexibility.

Pump Capacities

Dredges are usually equipped with either 12, 15, 18 or 20-inch dredging pumps; particularly has the 20-inch dredge become a standard. In larger sizes the handling of the discharge pipe on the fill becomes difficult, due to the weight of the piping. The capacity of a pump depends upon its size character of material and available power. In mud and silt 25 to 30 per cent of material can be handled with the water. In average dredging, however, making due allowance for stoppages and delays, the average output may be estimated at from 10 to possibly 15 per cent.

Power Required

The power required to drive the dredging pump depends upon the elevation above the surface of the water to which the material is to be raised, the length of pipe through which delivery is to be made, and the character of the material. In fine sand, silt or mud, a high velocity through the discharge pipe line is not necessary to obtain satisfactory results. In coarse, heavy sand and gravel, the velocity must be high.

Overcoming the friction through the discharge pipe, therefore, represents a large portion of the power that must be expended in driving the pump. In pumping water only, large pipes are used to reduce the velocity and frictional resistance and thus save power. In a dredging pump a high velocity is necessary, however, so that the material may be carried through the pipe without settling and choking the pipe. For most economical operation as regards power used, the velocity through the pipe line should not be higher than

is just necessary to carry the material satisfactorily.

As the frictional resistance decreases with larger sizes of pipe, it follows that with long pipe lines the larger dredge becomes the more efficient in use of power and operating cost per cubic yard handled. With easily handled material the delivery pipe may be a mile in length or more. With heavy material, requiring high velocity, the length of the pipe line can usually not exceed 4,000 to 5,000 feet. For a longer pipe line the pressure required on the dredging pump becomes too great; there will be difficulty in maintaining the rubber sleeves joining the pontoon pipe, and the wear on the dredging pump becomes excessive.

The practical maximum discharge pressure is from 45 to 55 pounds. For a long pipe line it, therefore, becomes necessary to use relay pumps; that is, the dredge pump delivers through a certain length of discharge pipe into the suction of a relay pump, which pump then delivers through the remainder of the pipe line. For high elevations and very long lines several relay pumps may have to be used.

The efficiency of a dredging pump is usually from 40 to 50 per cent. As the pump must be built with large openings to pass all classes of material the efficiency must be largely disregarded. The main requirement is ability to keep going.

For the sake of economy 15-inch and larger dredging pumps are usually directly connected to compound or triple expansion engines. There are many dredging pumps in service directly connected to electric motors, and also complete dredges in operation in which not only the dredging pump, but the cutter, hoisting engine, and in fact, all machinery, is operated by electricity. Where electricity can be obtained at a reasonable price this makes a very efficient dredge, requiring a smaller working force than a steam dredge.

To better adapt a dredge to the varying conditions of length of pipe line and elevation, it is well, with a directly connected pump, to provide several different diameters of impellers so as to enable the full boiler capacity and the maximum horsepower of the driving engine to be utilized at all times.

With a long pipe line a large diameter of impeller is required. If the same impeller was used with a short pipe line the engine speed would be held down so that the engine could not deliver its maximum power. Therefore, with the short line a smaller impeller should be used, enabling the engine to speed up and deliver its maximum power, and thus a greater amount of material be handled. The impeller should always be of enclosed type, as the open type, due to rapid wear, loses in efficiency.

Acknowledgement is given the Morris Machine Works, Baldwinsville, N. Y., for the above article.

New Roads to Have Stock Piles for Repairs.

New specifications for gravel and macadam roads in Michigan contain increased grading and drainage requirements on all types. The acceptance of roads for state reward has been made conditional upon the providing of a suitable road drag and the making of arrangements with some person to drag the road during the formative period. It is also required that at least 15 yards of gravel per mile be stocked in a neat pile for use in making repairs.

ASSOCIATION ACTIVITIES

Minnesota Organizes

AT A MEETING of the majority of the crushed stone operators in Minnesota, held at the West hotel, Minneapolis, Friday, March 8, a state association was formed and a splendid start made that will soon produce very marked results. A go-ahead policy was decided upon and is within the keeping of men capable of bringing success. Here, as elsewhere, the magnitude of the business in capital invested, number of men employed and the value of the product was surprising to all.

It was unanimously voted to incorporate under the name of The Crushed Stone Producers' Association of Minnesota. There is a good, live board of directors who will co-operate with the officers to promote the use of crushed stone on highways and in building construction. This board will determine the amount of dues and announce the same at an early date. Articles and by-laws were drawn up and accepted at the meeting.

C. D. Brewer, of the Duluth Crushed Stone Company, Duluth, presided and was made president of the new organization; B. F. Pay, of Fowler & Pay, Mankato, is vice-president, and Frank Ganley, of the Ganley Construction Company, Minneapolis, is secretary-treasurer. These men, with J. B. Robbins, of the Minnesota Crushed Stone Company and the St. Paul Crushed Stone Company; W. W. Brunett, of the Kettle River Company, Minneapolis; C. A. Ingwalson, of the Widell Co., Mankato; and G. W. Bestor, of the Sauk Rapids Granite Company, Sauk Rapids, and J. G. Hilder, St. Cloud, form the board of directors.

R. W. Scherer, secretary of the Wisconsin Crushed Stone Association, was on hand to explain the workings of the neighbor state organization. N. C. Rockwood represented the National Crushed Stone Association. It was decided to join the National, and C. D. Brewer and John Wunder were named as representatives on the board of the National body.

The firms represented at the meeting were:

Duluth Crushed Stone Company, Duluth.

Fowler & Pay, Mankato.

T. R. Coughlin, Mankato.

Widell Company, Mankato.

Minnesota Crushed Stone Company, Minneapolis.

St. Paul Crushed Stone Company, Minneapolis and St. Paul.

Ganley Construction Company, Minneapolis and Pipestone.

Sauk Rapids Granite Company, Minneapolis and Sauk Rapids.

J. G. Hilder, St. Cloud.

Kettle River Company, Minneapolis and Sandstone.

Trap Rock Company, Minneapolis and Dresser Junction, Wis.

Indiana Joins National Chamber.

WITH THE EYES of the business world directed toward Washington, there is added interest that from now on the Indiana Sand and Gravel Producers' Association has joined and will have a voice in the Chamber of Commerce of the United States. President Miller

received notification a few days ago that his association has been formally elected to membership in the central body, which numbers 998 commercial and trade organizations from every state in the Union and our outlying possessions.

P. A. Stewart, president of the Kickapoo Sand & Gravel Co., Attica, Ind., will represent the sand and gravel organization in the National Chamber. Hereafter, when policies affecting commerce are under discussion by the federal authorities, the Indiana Sand & Gravel Producers' Association will have a chance to express itself, inasmuch as one of the main purposes of the Chamber of Commerce of the United States is to voice the business sentiment of the country, a particularly important function in these times of war.

Highway Industries Committee Discusses Finance.

THE EXECUTIVE committee of the Highway Industries Association met in the Colorado Building, Washington, D. C., March 5. Those present were S. M. Williams, chairman; A. N. Johnson, W. P. Blair, E. J. Mehren, W. R. White, represented by Mr. Graham, and A. P. Sandles. Financial matters were principally discussed. There is a substantial sum already in the treasury and the sources of annual revenue were considered.

Mr. Sandles, representing the National Crushed Stone Association, stated that $500 had been voted annually by his association, but that individual stone plants would contribute if a program and policy was made and pursued that would give a fair promise to promote the cause of good roads building. Other committee members were in accord with this statement and Chairman Williams announced that in a few days he would outline a program and policy of the association.

A tentative budget was discussed covering the employment of a secretary, publicity man, stenographers

A. J. SULLIVAN

Mr. Sullivan is treasurer of the National Crushed Stone Association and one of the most active in its formation. His entire business career has been devoted to the stone industry, for he began at the age of seventeen, in 1895, with the Western Stone Co., Chicago, with whom he remained until the close of 1906. While connected with the Western concern he rose, in turn, to the positions of city salesman, country salesman and superintendent of sales.

In January, 1907, he became identified with the U. S. Crushed Stone Co., Chicago, as sales manager and was elected vice-president in 1914. Mr. Sullivan has been largely responsible for the organization and success of the Illinois Crushed Stone Association, serving as president in 1911, was re-elected in 1912, and retiring from the presidency in 1914. He was treasurer in 1914-1915 and again elected president in 1916, 1917 and 1918.

and other office help, field men, postage, printing, office rent, etc., which figures amount to nearly $50,000. Cashier Sands of the National Commercial Bank, Washington, D. C., and one of the leading men in Washington financial circles, was chosen treasurer.

Road Building Should Be on Program.

IT HAS BEEN stated by President Rhett of the U. S. Chamber of Commerce that highways may not be included in the discussion coming under the head of "Transportation" at the annual meeting in Chicago April 10-12. This turn of affairs is surprising, because at the Atlantic City gathering a few months ago a good roads resolution was adopted with great enthusiasm.

The proposed program will be confined to four questions in connection with the war—Shipping, Railways, Finance and Adjustment of Industries to war conditions and to conditions after the war. The situation has been called to the attention of President A. J. Blair of the National Crushed Stone Association by A. P. Sandles, secretary of the Ohio Macadam Association, and every member is urged to write to Mr. Rhett requesting that the subject of transportation be discussed under the three heads, "Highways," "Railroads" and "Waterways."

"It is absurd," Mr. Sandles stated, "for any man or set of men to ignore the question of highways, food and farm products when considering the essentials to the winning of this war. We must get busy and try to make the city banker and skyscraper business man see the error of their way of thinking."

Write to Hon. R. G. Rhett, president U. S. Chamber of Commerce, Charleston, S. C., and E. H. Goodwin, secretary U. S. Chamber of Commerce, Riggs Bldg., Washington, D. C.

Crushed Stone Directors.

Following is the revised list of directors of the National Crushed Stone Association, only a partial list having been published in the March issue:

California: Frank W. Bilger, Anton S. Blake.

Eastern Crushed Stone Association: F. W. Schmidt, John Rice.

Illinois: E. J. Krause, A. J. Sullivan.

Indiana: E. T. Milligan, E. B. Taylor.

Iowa: J. W. Crowley, Hale Roberts.

Michigan: R. M. Wallace, H. E. Bair.

Minnesota: C. D. Brewer, B. F. Pay.

Ohio: A. P. Sandles, E. T. Bell.

Ontario: R. Boyle, C. M. Doolittle.

Wisconsin: J. J. Sloan, J. D. Ohrt.

Western New York: W. L. Sporberg, James Savage.

Percentage of Sand and Gravel.

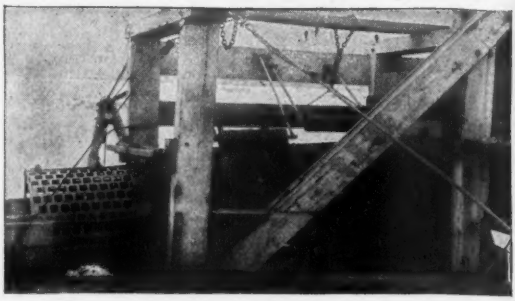
It is frequently necessary to know what percentage of the bank-run is sand and what gravel, or perhaps one may call it fine and coarse aggregate.

It depends somewhat on the purpose of the materials. For concrete everything that passes a ¼-inch mesh is called sand or fine aggregate, anything coarser is coarse aggregate. To find the percentages weigh out 100 pounds of the gravel just as it comes from the bank. Screen out the sand and weigh it. That gives the percentage of sand or fine aggregate. Pick out the boulders too large to use for concrete and weigh the rest of the gravel. That gives you the percentage of usable gravel. The boulders are waste unless they are to be crushed, in which case it should be done before screening.

MEN AND MACHINERY

Simple Screen Cleaner.

NOLL SCREEN CLEANERS consist of a number of rollers mounted above a revolving sand and gravel screen having a flexible, reticulated wall, with independent angular movement with respect to their rotative axis.



Screen Cleaner Mounted Above Sand and Gravel Screen

The material required to make one roller, or unit, consists of 1 piece of 5 inch tubing 6 inches long, with $\frac{3}{16}$-inch perforations to suit the mesh of the screen to be cleaned; 1 piece of 1½ inch gas pipe 6 inches long; 1 piece of wood filler 6 inches long, and 300 to 400 $\frac{3}{16}$-inch case hardened pins, 1¼ inches long.

A roller is assembled by driving the wood filler into the 5-inch tubing and drilling a hole through the center of the wood filler so that the 1½-inch gas pipe will fit in tightly, to form the bushing. The pins are then driven through the perforations in the tubing into the wood filler, allowing them to extend out $\frac{5}{8}$ of an inch. This completes the roller.

The swing frame is made of ¾-inch gas pipe, with washers and brackets, and supports a section of four rollers, which can be raised or lowered. The device is exceedingly simple, durable and easily repaired. It is manufactured by the Noll Screen Cleaner Co., Marietta, Ohio.

New Model Cableway Excavator.

SPEED is an important consideration in the successful operation of a slack line excavating outfit. While the total yardage which can be excavated in a given time is dependent to a large extent on the kind of material, length of cable and speed of engine, the time which the bucket takes to dump is an important item.

The 1918 Pioneer bucket, made by the Mansfield Engineering Company, Indianapolis, Indiana, is equipped with a back dump device, utilizing the well-known steam shovel hinge principle. A tripping device on the cable automatically opens the door as the bucket reaches the proper place on

the cable, and the bucket is dumped almost instantly. It dumps in from two to two and one-half seconds, averaging less than 2 per cent of the total time.

The Southern California Rock & Gravel Company, of Saticoy, Cal., are enthusiastic over the speed advantages and simple operation of the Pioneer back-dump bucket. Their equipment was installed in October, 1916, and has excavated to date over 100,000 yards of material, without giving trouble of any kind.

Serviceable Loader.

THOSE very serviceable loaders built by the Bay City Dredge Works, Bay City, Mich., are proving their worth at several gravel banks and stone quarries where no two sets of conditions are alike. This machine is also a speedy digger and makes an appreciable excavating record for quantity handled and at low cost, but it is especially noteworthy because of its portability. This feature is becoming more and more important.

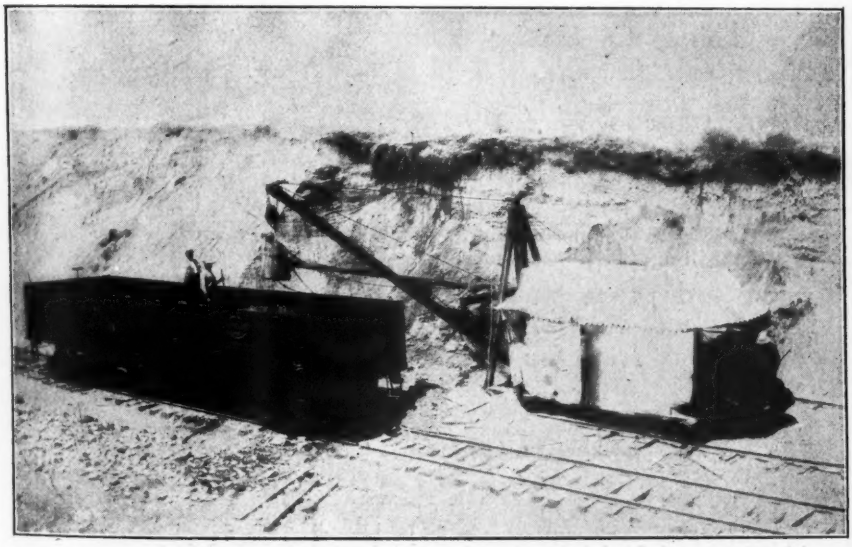
The machine can be obtained with walking traction if desired. It is built of steel and is easily dismantled and moved; has a long rotating arm, flexible control and ample power. Its makers claim that its operating and up-keep costs are surprisingly low.

The Equipment Corporation of America has succeeded the Chicago Builders' Specialties Co. The concern was established in 1902 and now has Chicago and Philadelphia warehouses, at which will be carried a full line of used locomotive cranes, locomotives, crushers, pumps, air compressors and other equipment suitable for sand and gravel and crushed stone operations. The Chicago office is at 1415 Lumber Exchange building. H. M. Capron is president and treasurer; G. A. Whitehead is vice president and Eastern manager.

Stone Spreader Saves Money.

BECAUSE of the uniformity in the spreading of stone by the Burch stone spreader it is considered a great saver of material and labor, eliminating the guesswork by the old method with its consequent rehandling cost in taking away surplus stone to points where there is not enough.

The device is 7 feet 4 inches long



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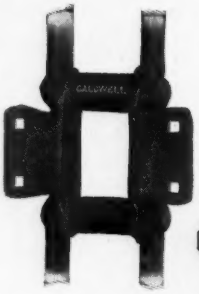

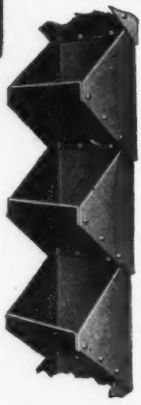

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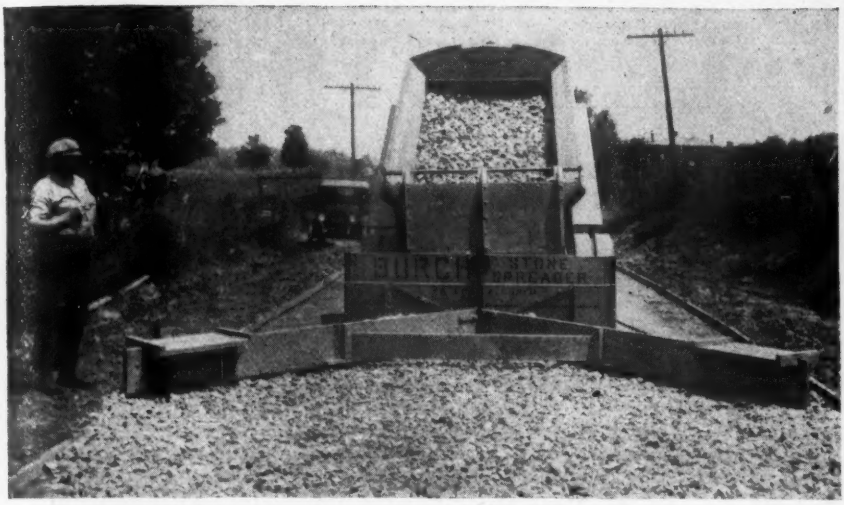
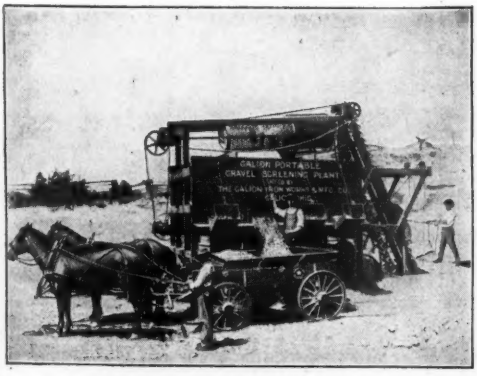


and can be attached to any make of motor truck by means of chains. The thickness of the stone is regulated by raising or lowering the gate. An even depth of stone is distributed at all times. The machine is strong and built for hard use.

Most pikes will permit of double drive so that the stone can be spread the entire width, leaving very little work to be done by hand. But if the pike is narrow and permits of only single drive, it is a very small task after distributing through the center with this machine to drag the stone out a couple of feet at each side. No stone need be hauled from one place to another. The spreader is manufactured by The Burch Plow Works Co., Crestline, Ohio.



PORTABLE SCREENING PLANT OVERCOMES LABOR SHORTAGE.

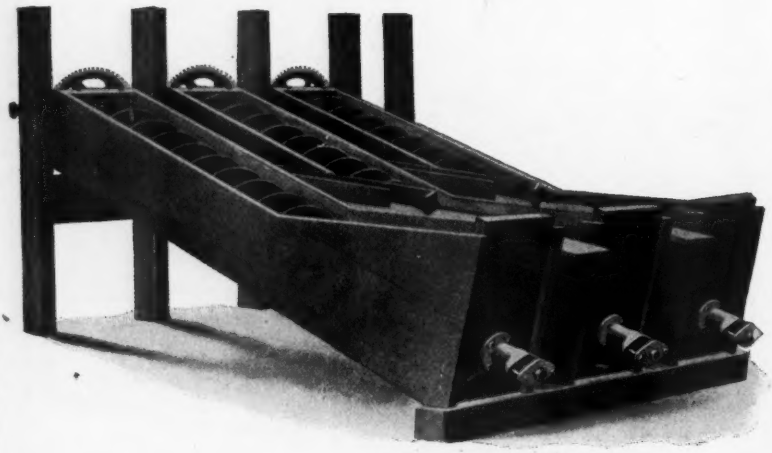
Portable Screening Plant.

A PORTABLE screening plant, with attendant excavating equipment is effecting a substantial saving of cost in road work in Kent county, Michigan, in spite of the fact that material is taken from two points of entirely different character. One deposit is in high bank form, permitting economical excavating, but the other lies in a shallow bed. A Sauerman dragline cable excavator obtains the material and carries it to the screen. Owing to the unfavorable excavating conditions the dragline cable method is a striking demonstration of its ability to overcome such obstacles.

The material is dumped into an elevated hopper and run through a crusher, because of the large proportion of big stones. It is then elevated to the screen over the bins and de-

"LEWISTOWN"

Sand Washers



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livered through spouts to the wagons, which carry it to the road work. Gravel that is still too big to go through the screen passes to a conveyor belt which in turn delivers to a chute that returns it to the crusher.

The crusher is a part of the portable screening plant, although detached from it. The screening plant, itself, consists of bins mounted on wheels, at the bottom of which are spouts of a suitable height from the ground to allow wagons to pass under them to be loaded. A revolving, cylindrical, inclined screen operates above the bins, and at the end of the plant is attached a bucket elevator.

C. L. Carlyle, of the Kent County Commission, is in charge of the obtaining of material and transporting it to the job. The Galion Iron Works & Mfg. Co., Galion, Ohio, furnished the crushing and screening equipment. The scarcity of labor suggested the advisability of securing such an outfit, for without something of this character road work would have been stopped. The equipment, however, has shown not only its adaptability for overcoming labor shortage but also that it is a decided money saver, as well as a practical plant combination.

Illinois Road Program.

Announcement has been made from Springfield that the distribution of $6,626,000 has been made available by the federal and Illinois state governments for the building of hard roads. The condition of Illinois roads at present is deplorable, being for the most part dirt roads. The appropriation will be distributed of follows: $1,413,000 for the National Old Trail Road from Indiana state line to E. St. Louis; $1,020,000 for the Lincoln Highway; $2,215,000 for the Chicago-Springfield road; $958,000 for the Springfield- E. St. Louis road; $614,000 for the Dixie Highway and $400,000 for the road from Chicago to the Wisconsin line.

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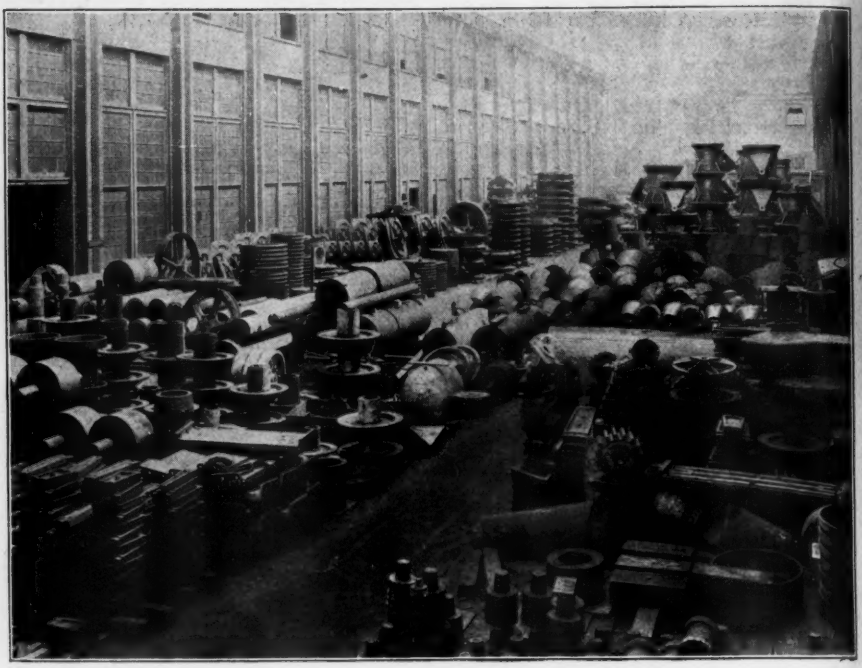

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